Fatores cognitivos relacionados à pedagogia do design: um estudo sobre a percepção de professores e estudantes.

Cognitive factors related to design pedagogy: a study of professors' and students' perception.

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diretrizes, submissão, artigo, modelo

O objetivo principal deste trabalho é coletar percepções de professores e estudantes de Design em relação aos resultados das pesquisas e pesquisas mais relevantes relacionadas à ciência cognitiva da memória aplicada à relação ensino-aprendizagem. A fim de verificar pontos de coesão e disparidades críticas em relação à prática da pedagogia do Design em relação aos estudos da memória, investigaram-se aspectos relacionados ao ensino do Design relacionados a três temas da ciência cognitiva: o primeiro, ligado à criação da memória, a segunda ligada ao papel do conhecimento prévio na criação dessas memórias e, finalmente, como efetivamente recuperar essas memórias no processo de ensino e aprendizagem. Para este fim, 21 professores de design e 49 estudantes e profissionais da área foram apresentados com 11 declarações relacionadas às novas teorias e evidências empíricas da ciência cognitiva. A percepção dos professores e alunos foi então analisada e comparada com as discrepâncias presentes e pontos de coerência, a fim de servir de base para projetos de ensino na área do Design. O principal ponto de discordância, no entanto, é se aplicar testes para avaliar o conhecimento prévio dos alunos no início dos assuntos. Enquanto quase 75% dos professores relataram fazer essa avaliação, mais de 90% dos estudantes e profissionais entrevistados afirmaram que não haviam sido abordados em relação ao conhecimento prévio no início das disciplinas de design. Ainda sobre o tema da criação da memória, há pontos críticos e importantes em relação à compreensão da memória como resultado do processo de pensamento. Os resultados mostram uma atitude neutra dos professores em relação a este conceito, enquanto os alunos tendem a concordar com a ideia de que as memórias são o resultado do processo de raciocínio. Por fim, o último ponto em relação a este tema refere-se às dificuldades criadas pelos professores no processo de criação da memória e ao esforço e maturidade dos alunos que enfrentam esses obstáculos. Os resultados apontam para uma visão negativa dos alunos em relação à criação de dificuldades intencionalmente oferecidas pelos professores para melhorar o desempenho da aprendizagem. Por sua vez, os professores apontam que na maioria das vezes os alunos reagem aos desafios e dificuldades de forma madura e positiva. Em relação ao último assunto investigado, referente à recuperação da memória, o único ponto discrepante entre os sujeitos da pesquisa refere-se ao tempo dedicado à recuperação de memórias. Sobre este tópico especificamente, os professores permaneceram neutros enquanto os estudantes acreditam que a recuperação efetiva deve realmente levar tempo, como dizem a teoria e os mais recentes estudos empíricos no campo da ciência cognitiva. Com base nessas descobertas, cursos e professores de design podem estabelecer maneiras de diminuir as discrepâncias mais críticas relacionadas aos aspectos cognitivos da pedagogia e do ensino de design.

cognitive science; design education; memory creation; prior knowledge; memory retrieval

The main objective of this work is to collect perceptions of Design teachers and students in relation to the results of the most relevant research and research related to memory cognitive science applied to the teaching-learning relationship. In order to verify points of cohesion and critical disparities in relation to the practice of Design pedagogy in relation to memory studies, aspects related to the teaching of Design related to three themes of cognitive science were investigated: the first, linked to memory creation, the second linked to the role of prior knowledge in the creation of these memories, and, finally, how to effectively recover those memories in the process of teaching and learning. To this end, 21 design professors and 49 students and professionals in the field were presented with 11 statements related to the new theories and empirical evidence of cognitive science. The perception of teachers and students was then analysed and compared to present discrepancies and points of coherence in order to serve as the basis for instructional projects in the area of Design. The main points of disagreement found in the results refer to the role of students' prior knowledge regarding the impact of pedagogical practices that differ between teachers and students. Also on this topic, a discrepancy between the teachers' view on the

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evaluation of students' prior knowledge at the beginning of the subjects compared to the students' own perception was revealed. At first, the results show that teachers have an excessively neutral position in relation to the impact of prior knowledge of students in the learning process, but they believe that prior knowledge can offer more impact on learning than pedagogical practices. On the contrary, students think that in relation to this topic, pedagogical practices would have greater impact than previous knowledge, being in disagreement with theory and new empirical studies on the subject. The main point of disagreement, however, is whether to apply tests to assess the prior knowledge of students at the beginning of the subjects. While almost 75% of teachers reported doing this assessment, more than 90% of the students and professionals interviewed stated that they had not been approached in relation to prior knowledge at the beginning of design disciplines. Still on the theme of memory creation, there are critical and important points regarding the understanding of memory as a result of the thought process. The results show a neutral attitude of teachers towards this concept, while students tend to agree with the idea that memories are the result of the reasoning process. Lastly, the last point in relation to this theme refers to the difficulties created by teachers in the process of memory creation and to the effort and maturity of students facing these obstacles. The results point to a negative view of the students regarding the creation of difficulties intentionally offered by teachers to improve learning performance. In turn, teachers point out that most of the time students react to challenges and difficulties in a mature and positive way. In relation to the last subject investigated, referring to the memory retrieval, the only disparate point between the subjects of the research refers to the time dedicated to the recovery of memories. On this topic specifically, teachers have remained neutral while students believe that effective recovery must really take time, as theory and the latest empirical studies in the field of cognitive science say. Based on these findings, design courses and professors can establish ways to diminish the most critical discrepancies related to the cognitive aspects of design pedagogy and teaching.

1 Introduction

The basic theory of how we learn has been evolving in the last century. As the margins of the field are increased, the science of learning, cognitive science, and memory related studies have proven that there are not an only perfect path regarding learning, but variable strategies that can be adapted for each kind of information.

This study will investigate some topics and aspects regarding memory and learning science in design teaching and learning, including: role of memory in learning with emphasis on creating memories, prior knowledge impact on new ones and how to retrieve memories. Statements on those topics were presented to design students and professors to investigate accurate and inaccurate perceptions related to new findings on those themes.

Memory and Learning

The new theory of learning shows that memory wants to forget (Carey, 2014). To forget is not to fail for the brain, points the new studies approach. Forgetting is a natural and benefit filter, most times based in the disuse theory. But the brain has two distinct forces that are important to understand: the retaining and the retrieval force. The first one is related to the capacity to acquire effectively new information, the second one is related to the capacity to recall previous informations acquired. (Carey, 2014)

Memory is a key factor in learning process. Some concepts are important to understand its structure and contemporary approach in learning theories. First aspect is related to previous knowledge, as already existing knowledge will increase successful link to new information, resulting in long-lasting memories. Secondly, to memories become enduring and retrievable, it's important to process and think more about new information. It involves dialogue between short-term and long-term memory, it's necessary to think if you want to learn. (Dewey, 1916)

Creating Memories

(Willingham, 2009) makes a profound statement when he affirms that memories are the residue of thought. It means that the process of learning and making long-term memories is an active process. By consciously processing information, we link the new to what already exists in our memories. For example, a not uncommon mnemonic strategy is to make a story out of the new

information, thus the narrative makes one think about how to connect it, and will make the words more memorable. By creating an active dialogue between working memory and long term memory, by thinking to learn, we extend, elaborate, connect, modify, and/or consolidate new memories. Struggles can actually enhance learning. Difficulties and effort are important factors, that deepens and endures learning. The error, in this context can be viewed as a fine step for learning with an occult value: the test can be used as a powerful study technique and must be applied soon.(Spitzer, 1939)

(Bjork, 1978) call this desirable difficulties, that should be intentionally created by teachers, because difficulties that engage deeper processing within the learner's capacities are good. In 1916, DEWEY in his book Democracy and Education, over a century ago affirmed: "Give the pupils something to do, not something to learn, and if the doing is of such a nature as to demand thinking, learning naturally results." (Dewey, 1916)

As Ausubel said in one of the first textbooks published about cognitive science, "The most important single factor influencing learning is what the learner already knows. Ascertain this and teach accordingly."(Ausubel, 1968)

Prior Knowledge

Literature points that effective teaching is achieved by starting with the learner in mind. Shulman & Shulman, (2004) presents the importance of prompt learning, and inside out process, as what teachers do pedagogically is not the first influence on new learning, but the learning that's already inside the learner. (Bransford & Johnson, 1972) performed a study to exemplify how having access to relevant knowledge influences comprehension and understanding as well as memory formation and recall. For conclusion, if students have appropriate, retrievable, and accurate prior knowledge to link new knowledge to, learning will happen more readily and will stick in enduring ways. AUSUBEL wrote that the most important single factor influencing learning is what the learner already knows, if it's ascertained, just teach accordingly. (Ausubel, 1978)

Retrieving Memories

Literature often indicates to think of retrieval during encoding. Unfortunately, this important aspect of enduring and transferable learning is often overlooked in learning designs. That involves also the need to design some cue points along the way. The literature categorizes these cues as information from our surrounding that causes us to begin the process of memory retrieval. It could be smells, sounds and also words in a book or a question somebody asks. The recall or the process of memory retrieval are of two categories: Free recall and Cued recall. Free recall is harder to do, because it simply takes more work to search your memory, and to respond to those general sorts of cues. On the other hand, free recall is a way to retrieve memories, it is very effective as a way to make memories that last longer and are easier to retrieve. The cognitive effort required not only modifies in more specific and organized ways prior memory being recalled, but it also allows the learner to develop retrieval cues for that memory rather than relying on some external cue like a teacher's verbal question, a written quiz, or a study guide question. To design effective learning experiences for students, some important concepts were found in literature:

- Match memory and coding with memory retrieval,
- Organization helps retrieval,
- Effective retrieval should take time,
- Knowing purpose and meaning make retrieval easier.

2 Methods

The focus of this research, relies on cognitive factors regarding design pedagogy, and will be intended to inform teaching practice. This work is a qualitative study based on subjective

evaluation of specific aspects of cognitive science regarding learning in design courses. Twenty one professors and forty-nine design students answered a survey containing eleven statements regarding three main areas or themes on cognitive science findings: the first is the connection of new content to prior knowledge, the second, the process to create new memories. Finally, four statements regarding the process of retrieving memories were presented to collect subjective perceptions. (TABLE 01)

Table 01: Basic research design.

THEME	STATEMENTS	MEASUREMENT / SCALE
PRIOR KNOWLEDGE	1. Effective teaching is achieved by starting with the learner in mind. 2. What teachers do pedagogically is more influential on learning than students' prior knowledge. 3. If students have appropriate, retrievable, and accurate prior knowledge to link new knowledge to, learning will happen more readily and will stick in enduring ways. 4. I assess my student´s prior knowledge, related to intended content and themes, on the beginning of disciplines. b. Professors assessed my prior knowledge, related to intended content and themes, on the beginning of disciplines.	● I Totally Agree ● I Agree ● Neutral ● I Disagree ● I Totally Disagree ● Never ● Rarely ● Frequently ● Always
CREATING MEMORIES	1. Memories are the residue of thought. 2. Difficulties, should be intentionally created by teachers, because they engage deeper processing within the learner's capacities. 3. Students react to difficulties and challenges with a mature and positive approach. b. Professors created good challenges and difficulties to improve my learning performance.	● I Totally Agree ● I Agree ● Neutral ● I Disagree ● I Totally Disagree ● Never ● Rarely ● Frequently ● Always
RETRIEVING MEMORIES	1. Performing activities regarding memory recall and recovery are beneficial to the learning process. 2. Organization helps retrieval. 3. Effective retrieval should take time. 4. Knowing purpose and meaning make retrieval easier.	1. I Totally Agree 2. I Agree 3. Neutral 4. I Disagree 5. I Totally Disagree 6. Never 7. Rarely 8. Frequently 9. Always
TOTAL: 11 QUESTIONS		

This research design was developed with the intention of understanding the impact of cognitive factors in design education, by compared perspectives.

3 Results and Discussion

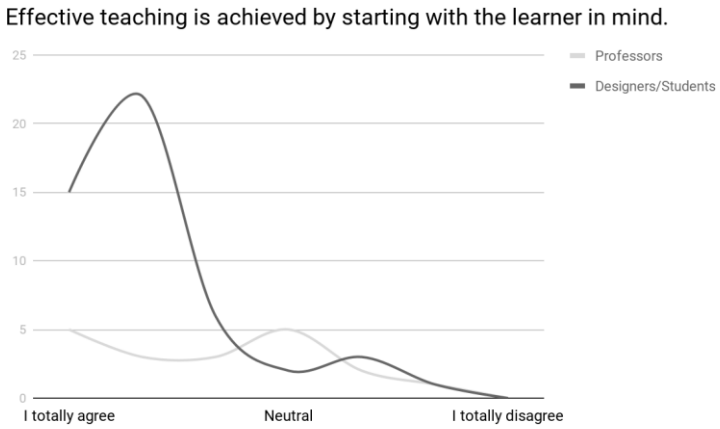
The premise of this research is to present cognitive science in a way intended to inform design teaching practice. In order to do that, this paper confront design students and professors to the science of memory empirical evidence, to understand their perspective on those themes.

Prior Knowledge

As previously stated, four statements were presented regarding to the previous knowledge of the student to form a better connection with classroom content to be given by the teacher. Among the statements, were questions related to the intention of the teacher to initiate a discipline starting with the knowledge that the student already has. In addition to this factor, another statement related to the value of the student's previous knowledge was placed, confronting the pedagogical activities set up by the teachers. Also, an affirmation was presented that established a positive relationship between the success of learning a new material or content, related to its connection with appropriate prior knowledge that is correct and easily memorable. Finally, it was asked to the students and professors of design if in the beginning of the disciplines the previous knowledge was evaluated.

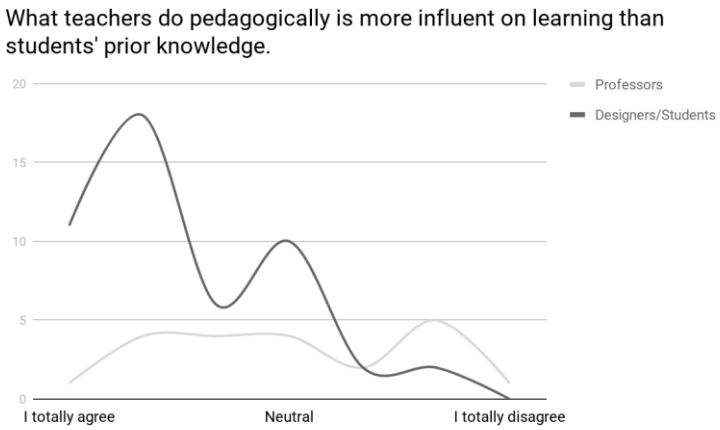
In figure 1, we see a discrepancy between the point of view of students and design teachers. Teachers tend to be neutral about the assertion that effective teaching is achieved when one begins to think of the teaching process from what the student already knows. Meanwhile, students tend to be more positive about this statement.

Figure 01: Perception regarding prior knowledge.



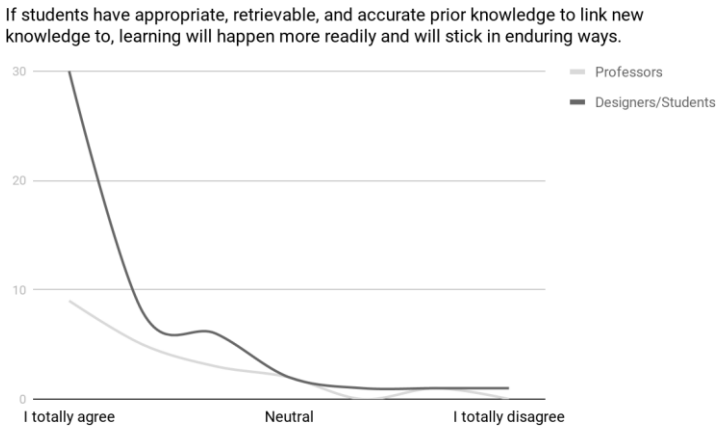
While students tend to agree that what a teacher does pedagogically influences more of their learning than necessarily their prior knowledge, teachers disagree with this statement. As presented earlier, teachers have a more correct and more appropriate view of the process by being more in line with the empirical evidence of cognitive science and memory studies, as shown in figure 2.

Figure 02: Perception regarding prior knowledge.



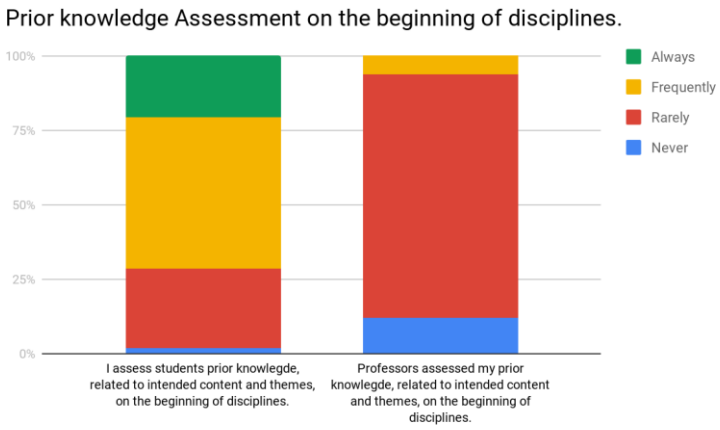
Both teachers and design students agree that when students have prior, correct, accessible, and appropriate knowledge to connect new information, learning will occur in an easier and more lasting way. As we can see in figure 3, the two types of subjects investigated tend to agree totally with the statement.

Figure 03: Perception regarding prior knowledge.



But is the prior knowledge of design students really measured and evaluated by teachers before the start of each discipline? This was the question that was asked for both categories of interviewees and the results are presented in Figure 4. It clearly shows the difference in perception between students and teachers. Almost 90% of students report that teachers seldom assess their prior knowledge at the beginning of the course, while almost 75% of teachers state that they often evaluate students' prior knowledge at the beginning of the course.

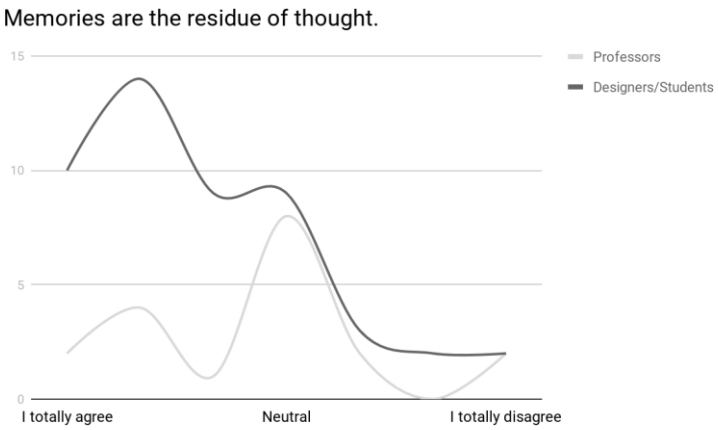
Figure 04: Perception regarding prior knowledge.



Creating Memories

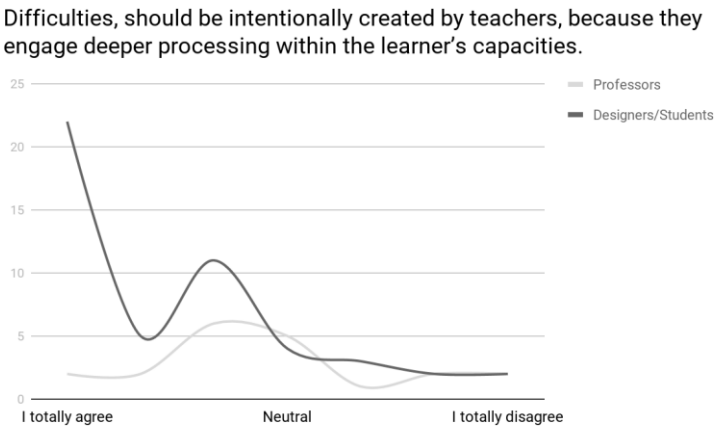
In relation to the process of creating new memories, four statements were made by confronting the point of view of teachers and design students. As shown in Image 5, students tend to have a more positive perception regarding the process of thinking to create memories while teachers tend to have a more neutral posture. In this case, the students agreed with the evidence of the science of memory and cognitive science, which confirm that the most lasting memories are those formed within a reasoning process.

Figure 05: Perception regarding memory creation.



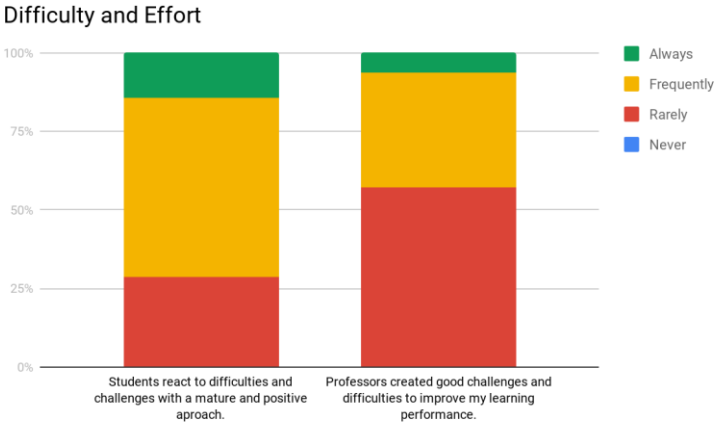
Another important aspect to make memory creation efficient has to do with the existence of difficulties within the process. The literature of the area points out that difficulties, which can even be intentionally created by teachers and instructors, are able to engage a deeper learning process within the abilities of students creating more lasting memories. However, as shown in figure 6, teachers tend to position themselves in a neutral way in relation to this statement. Some significant parts of students also position themselves well, even though another significant part has a positive view of difficulties during the learning process.

Figure 06: Perception regarding memory creation.



To complement the research on the relationship between difficulty and effort in the process of creating memories, teachers and design students were asked about these themes. For teachers, the following statement was made: students react to difficulties and challenges with maturity and positivity. For students, the statement was related to the fact that teachers created good challenges and difficulties in order to improve students' learning performance. For this research, we found the following positions: about 75% of teachers believe that often or always present students with good challenges and students react to difficulties and challenges in a mature and positive way. However, more than 50% of the students say that teachers rarely create good challenges and difficulties, whose goal is to improve learning performance.

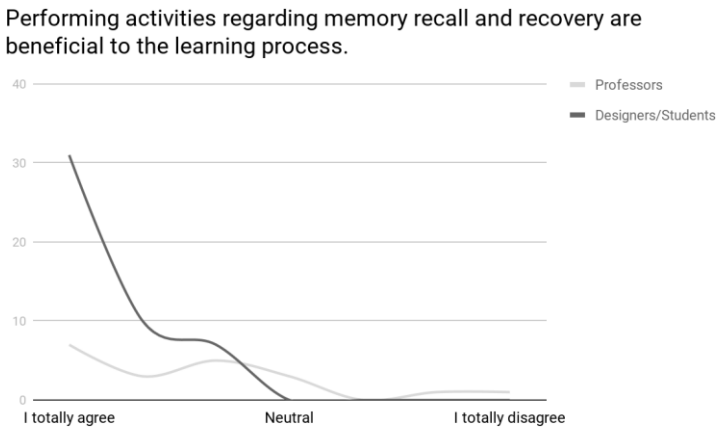
Figure 07: Perception regarding memory creation.



Retrieving Memories

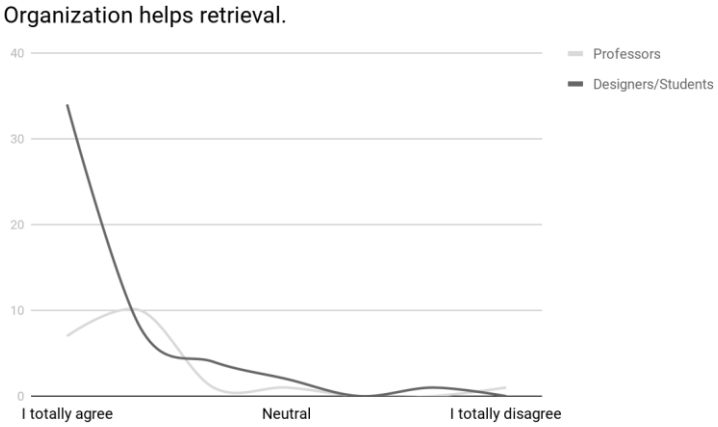
Researches point out that performing activities to remember memories are beneficial to the learning process. Especially when trying to recall a memory is not supported by the use of drafts books or notes, the process becomes richer for learning and the formation of more lasting memories. On a statement made in this regard, both teachers and students present a positive attitude and agree with this finding.

Figure 08: Perception regarding memory retrieving.



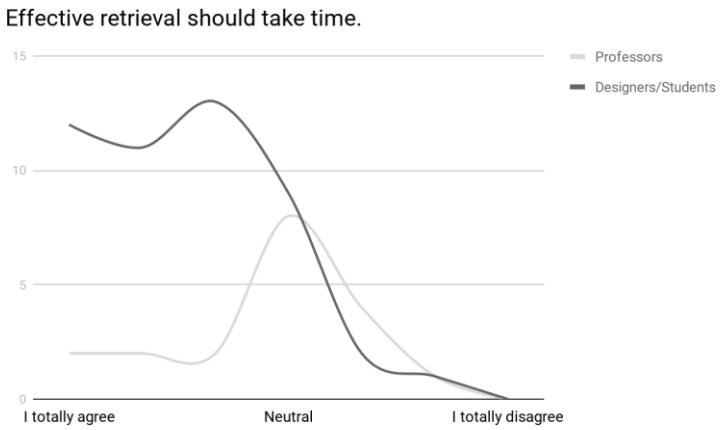
Still in a way consonant with the research related to memory science, both teachers and students of design, understand that the organization helps in the recovery of memory as seen in the image 9.

Figure 09: Perception regarding memory retrieving.



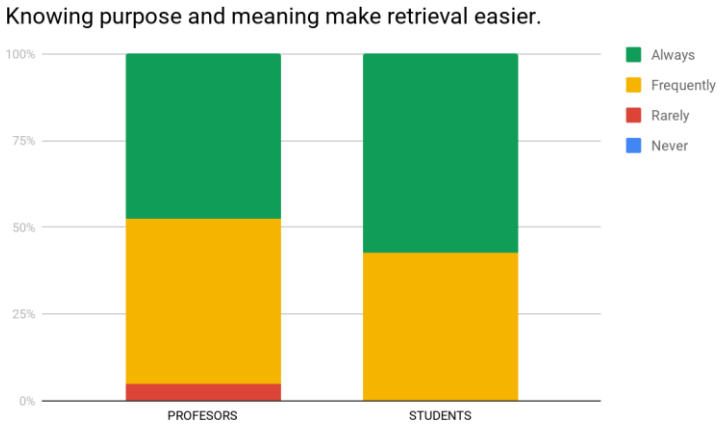
Differently from previous statements, in which the understanding of teachers and design students were similar and according to memory theory and its recent findings, the time of memory recovery was disastrous. When presented with the claim that effective memory retrieval should take time, students tend to agree while teachers remain neutral about the statement.

Figure 10: Perception regarding memory retrieving.



Still within the theme of memory recovery and as presented in figure 11, the vast majority of students and teachers understand that always or frequently knowing the purpose and meaning of what is learned helps and facilitates the retrieval of information.

Figure 11: Perception regarding memory retrieving.



4 Conclusions

The importance of this study is to reveal the perceptions of students and teachers of design regarding the formation of memories and the cognitive factors linked to the pedagogy of Design. The results of this research can be used in a comparative way to other courses and areas, to establish guidelines for the instructional practice of teachers, within several courses and to present ways for the development of educational technologies.

With regard to the prior knowledge of students, the results show that design professors should make clear and evaluate the prior knowledge of their students at the beginning of the subjects. Still, students seem to value when the learning process when teachers begin the teaching process taking into consideration what the student already knows.

Another critical point found by the research concerns the fact that design students tend to think that what teachers perform pedagogically influence the learning process more than their prior knowledge. While teachers tend to disagree with this view by valuing the student's previous knowledge more than their own pedagogical possibilities.

In relation to the effort and difficulties in the learning process to create lasting memories, teachers should make clear the intention and the role of the challenges and obstacles placed in disciplines. This finding is even more important when we realize that students tend to value the learning process and find facilities for retrieving memories when they know the purpose and meaning of that content.

Another discrepancy in the perception of teachers and students has to do with the time required to make successful recovery of memory. While students believe that the process may take time, teachers presented a neutral point of view regarding this statement. Based on these findings, design courses and professors can establish ways to diminish the most critical discrepancies related to the cognitive aspects of design pedagogy and teaching.

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